

## **REMARKS**

### **Claim Status**

Claims 1-19 are presented for examination, with claim 1 being the only independent claim. Claims 1, 2, 9, 18 and 19 have been amended. Support for the amendment to independent claim 1 may be found, for example, at pg. 5, lines 24-26 of the specification as originally filed. Support for the amendment to dependent claim 19 may be found, for example, at pg. 14, line 39 to pg. 15, line 2 of the instant specification. The amendments to dependent claims 2 and 18 are to correct a minor claim wording, and are cosmetic in nature. No new matter has been added. Reconsideration of the application, as herein amended, is respectfully requested.

### **Overview of the Office Action**

Claims 1, 9 and 19 stand rejected under 35 U.S.C. §112, second paragraph, as indefinite for failure to particularly point out and claim the subject matter which applicant regards as the invention. Withdrawal of this rejection is in order, as explained below.

Claims 1, 2, 8, 11-13, 18 and 19 stand rejected under 35 U.S.C. §102(b) as anticipated by U.S. Patent No. 6,434,180 ("*Cunningham*"). Claims 1, 18 and 19 stand rejected under 35 U.S.C. §102(b) as anticipated by U.S. Pub. No. 2002/0146053 ("*Iwai*"). Claims 1, 2, 4 and 7-10 stand rejected under 35 U.S.C. §102(b) as anticipated by U.S. Pub. No. 2002/0054618 ("*Jiang*").

Claim 3 stands rejected under 35 U.S.C. §103(a) as unpatentable over *Jiang* in view of U.S. Patent No. 5,719,891 ("*Jewell*"). Claim 6 stands rejected under 35 U.S.C. §103(a) as unpatentable over *Jiang*. Claims 11-17 stand rejected under 35 U.S.C. §103(a) as unpatentable over *Cunningham* in view of U.S. Patent No. 6,370,168 ("*Spinelli*").

Applicants have carefully considered the Examiner's rejections, and the comments provided in support thereof. For the following reasons, applicants assert that all claims now pending in the present application are patentable over the cited art.

### **Descriptive Summary of the Prior Art**

*Cunningham* discloses "a cavity design that effectively couples together the cavities of the two VCSELs such that the electric field of the pumping light emitted by the short-wavelength VCSEL extends at significant strength beyond the cavity of the short-wavelength VCSEL and into the gain medium of the long-wavelength VCSEL" (see col. 2, lines 53-58).

*Iwai* discloses "a GaInNAs-based surface emitting laser having a longer emission wavelength, with a higher emission efficiency, an improved temperature characteristic and a longer wavelength" (see paragraph [0025]).

*Jiang* discloses a "[m]odulated integrated optically pumped vertical cavity surface emitting lasers [which] are formed by integrating an electrically pumped semiconductor laser and a vertical cavity surface emitting laser (VCSEL) together with a means of direct modulation of the electrically pumped semiconductor laser" (see Abstract).

*Jewell* discloses "a partially oxidized electrically conductive element in which the lateral extent of the oxidation is controlled" (see col. 2, lines 55-57).

*Spinelli* discloses "[a]n intracavity, frequency-doubled, external-cavity, optically-pumped semiconductor laser ... [which] ... includes a semiconductor multilayer surface-emitting gain-structure surmounting a Bragg mirror" (see Abstract).

### **Summary of the Subject Matter Disclosed in the Specification**

The following descriptive details are based on the specification. They are provided only for the convenience of the Examiner as part of the discussion presented herein, and are not intended to argue limitations which are unclaimed.

The specification discloses a semiconductor laser device comprising an optically pumped surface-emitting vertical emitter region which has an active radiation-emitting vertical emitter layer, and at least one monolithically integrated pump radiation source for optically pumping the vertical emitter, which has an active radiation-emitting pump layer. The main direction of radiation of the pump radiation is lateral. The pump layer follows the vertical emitter layer in the vertical direction, and a conductive layer is provided between the vertical emitter layer and the pump layer. Furthermore, a contact is applied on the side of the semiconductor laser device which is closer to the pump layer than to the conductive layer. An electrical field applied between this contact and the conductive layer results in the generation of pump radiation by charge carrier injection.

The vertical emitter layer and the pump layer are layers which are vertically separated from one another and which have been grown in succession. This structure ensures a greater level of freedom in the choice of their layer dimensions and materials. The wavelength of the pump radiation and the vertically emitted radiation can be adjusted within wide limits, which permits the achievement of a high pumping efficiency. The claimed arrangement of the conductive layer and the contact on the side of the semiconductor laser device thus leads to charge carriers being selectively injected into the pump layer and not into the vertical emitter layer by an electrical field that is applied between the conductive layer and the contact. The

claimed arrangement prevents excitation of parasitic laterally propagating radiation in the vertical emitter layer.

#### **Amendments Addressing Formalities**

The Examiner rejected claims 1, 9 and 19 as indefinite. In response to each specific rejection, applicants have amended these claims in a self-explanatory manner. Withdrawal of the rejections is therefore deemed to be in order.

#### **Patentability of Independent Claim 1 under 35 U.S.C. §102(b)**

Independent claim 1 has been amended to recite “wherein the pump layer follows the vertical emitter layer in the vertical direction and radiation from the monolithically integrated pump radiation source is emitted mainly laterally”. Support for this amendment to independent claim 1 may be found, for example, at pg. 5, lines 24-26 of the specification as originally filed. No new matter has been added.

*Cunningham* (col. 5, lines 55-57; FIG. 4) discloses “a structure 110 that includes a long-wavelength VCSEL 114 that is optically pumped up by a short-wavelength VCSEL 112”. *Cunningham* (col. 6, lines 55-57; FIG. 4) explains that it is feasible to include a number of quantum wells, and preferably at least six, in a gain medium 125 of the structure because of the stronger field of the pumping light in the gain medium”. However, *Cunningham* fails to teach or suggest that the direction of radiation from the pump radiation source is primarily lateral, as now recited in amended independent claim 1.

*Iwai* discloses a surface emitting laser which is implemented as a combination laser including a pair of laser sections monolithically formed on a single GaAs substrate (see

paragraph [0036]; FIG. 3). *Iwai* (paragraph [0046, lines 2-5) explains that “the laser emitted by the first laser section 52 and having an emission wavelength of 850 nm pumps the GaInNAs-based QW active layer structure (or absorption region) of the second laser section 53”. *Iwai* also fails to teach or suggest that the emitted radiation is mainly in the lateral direction, as now recited in independent claim 1.

*Jiang* discloses “[m]odulated integrated optically pumped vertical cavity surface emitting lasers [which] are formed by integrating an electrically pumped semiconductor laser and a vertical cavity surface emitting laser (VCSEL) together with a means of direct modulation of the electrically pumped semiconductor laser” (see Abstract). *Jiang* (paragraph [0046], lines 2-3) explains that the pump laser is split into two sections; as shown in FIGS. 3A-3B, FCSEL 140” is split into a first section 301 and a second section 302. The parasitics as seen from the point of view of the electrical connections to the pump laser are also split in two. As a result, the dynamic parasitics associated with data modulation of the first section 201 through the first contact terminal 208A and of the first section 301 through the first contact terminal 310A are reduced from that of modulating the top contact terminal 108 of FIGS. 1A-1B. However, there is no teaching or suggestion in *Jiang* that these sectioned segments of the pump laser emit pump radiation laterally.

Each of the cited references discloses a vertical emitter that is optically pumped by another electrically pumped vertically emitting semiconductor layer. In each of the devices disclosed in *Cunningham*, *Iwai* and *Jiang*, the main portion of the pump radiation and the radiation that is finally emitted from the device are radiated in the same direction, i.e., in the vertical direction and parallel to each other. Independent claim 1, on the other hand, now recites that radiation from the monolithically integrated pump radiation source is emitted mainly laterally. In this arrangement,

the pump radiation is emitted perpendicular to the radiation emitted by the optically pumped vertical emitter.

In view of the foregoing, it is apparent that *Cunningham*, *Iwai* and *Jiang* each fail to teach or suggest the recitations now present in independent claim 1. Independent claim 1 is accordingly deemed to be patentable over *Cunningham*, *Iwai* and *Jiang*, and reconsideration and withdrawal of the rejections of claim 1 under 35 U.S.C. §102 are requested.

Moreover, by virtue of the above-discussed differences between the recitations of claim 1 and the teachings of *Cunningham*, *Iwai* and *Jiang*, and the lack of any clear motivation or basis for modifying *Cunningham*, *Iwai* or *Jiang* to achieve applicants' claimed invention, independent claim 1 is likewise deemed to be patentable over *Cunningham*, *Iwai* and *Jiang* under 35 U.S.C. §103.

**Patentability of Dependent Claims 3 and 14-17 under 35 U.S.C. §103**

The Examiner (at pg. 9 of the Office Action) acknowledges that *Jiang* fails to teach or suggest "parallel trenches," as recited in dependent claim 3, and cites *Jewell* for this feature. The Examiner (at pg. 10 of the Office Action) also acknowledges that *Cunningham* fails to teach or suggest "the vertical emitter being associated with an external resonator reflector which together with the internal cavity reflective structure, forms a resonator for the vertical emitter region, beam shaping elements, frequency-selective elements, and frequency-converting elements [that] are arranged in the resonator," as recited in dependent claims 14-17, and cites *Spinelli* for these features.

Applicants, however, contend that no combination of *Jiang*, *Cunningham*, *Jewell* and/or *Spinelli* achieves the subject matter of independent claim 1, from which claims 3 and 14-17

depend. There is simply nothing in *Jewell* and/or *Spinelli* to cure the above-discussed deficiencies in *Cunningham* and *Jiang*, e.g., the lack of teachings relating to applicants' claimed lateral direction of emitted radiation as recited in amended independent claim 1.

*Jewell* discloses "semiconductor devices whose current flow is controlled by layers which are oxidized over part of areas" (see col. 1, lines 6-8). *Spinelli* discloses "an OPS-structure including a multilayer gain-structure surmounting a multilayer mirror-structure" (see col. 2, lines 24-25). *Spinelli* (col. 4, lines 15-18; FIG. 1) explains that a "pump-radiation source 22 is arranged to deliver pump-radiation to gain-structure 14 of OPS-structure 12, for generating laser-radiation in laser-resonator 18".

*Jewell* and *Spinelli*, however, fail to teach or suggest anything whatsoever with respect to the claimed lateral direction of generated radiation of amended independent claim 1. Each of the cited references thus fails to teach or suggest the express recitations of applicants' independent claim 1. Since *Cunningham*, *Jiang*, *Jewell* and *Spinelli*, individually or in combination, fail to teach or suggest the features recited in independent claim 1, dependent claims 3 and 14-17 are deemed to be patentable based at least on their dependency from claim 1.

### **Dependent Claims**

In view of the patentability of independent claim 1 for the reasons presented above, each of dependent claims 2-19 is respectfully deemed to be patentable therewith over the prior art. Moreover, each of these claims includes features which serve to still further distinguish the claimed invention over the applied art.

## **Conclusion**

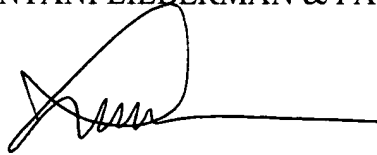
Based on all of the above, applicants submit that the present application is now in full and proper condition for allowance. Prompt and favorable action to this effect, and early passage of the application to issue, are solicited.

Should the Examiner have any comments, questions, suggestions or objections, the Examiner is respectfully requested to telephone the undersigned to facilitate an early resolution of any outstanding issues.

It is believed that no fees or charges are required at this time in connection with the present application. However, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,  
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